

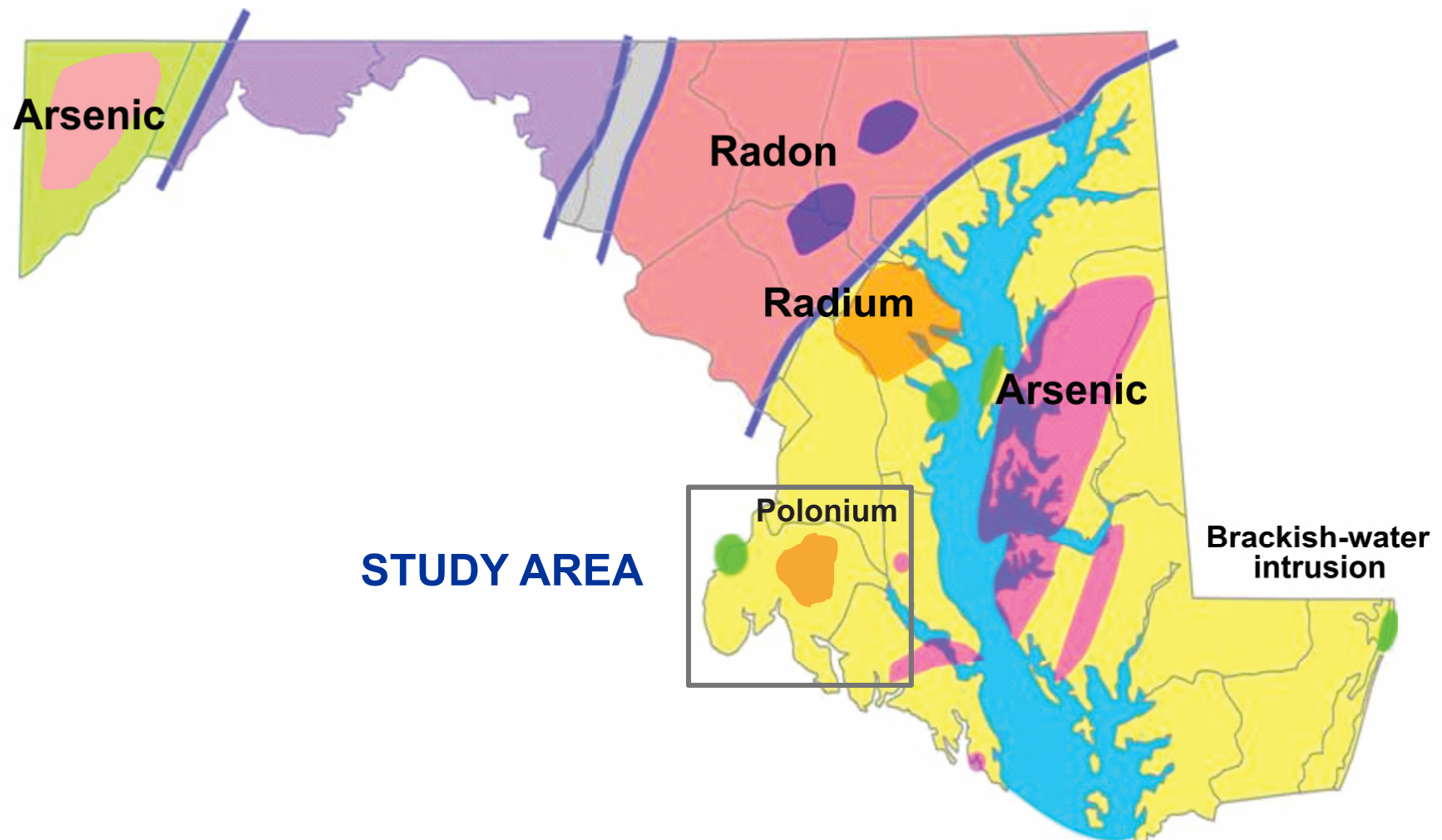


Elevated Radioactivity in Groundwater in Charles County, Maryland

**David W. Bolton (presenter) and David C. Andreasen
Maryland Geological Survey
Maryland Department of Natural Resources**

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Regional Groundwater Quality Issues in Maryland



BACKGROUND

- 1998: Gross alpha-particle activity (GAPA) >15 pCi/L in Chapel Point Woods water system, Charles County, Maryland
- Four other water systems exceeded 15 pCi/L GAPA
- Radium-226 + radium-228 were below 5 pCi/L
- Polonium-210 detected in two systems (maximum: 46 pCi/L)

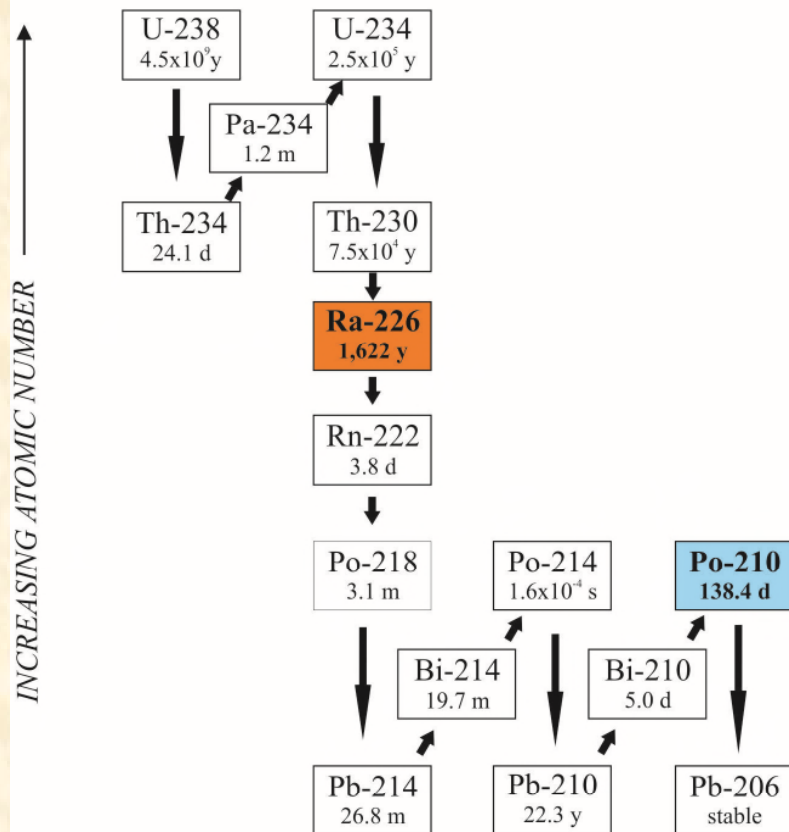
QUESTIONS

- Is radioactivity restricted to a particular stratigraphic interval(s)?
- Are private water wells at risk?
- Why here?

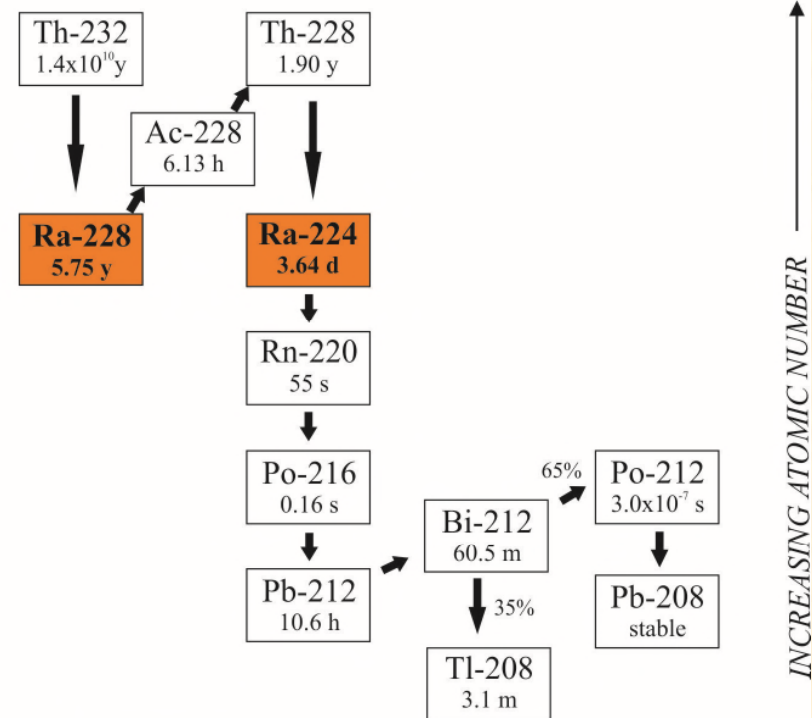
STUDY OBJECTIVES

- 1) Compile and document existing data on radioactivity in groundwater in Charles County, Maryland (Maryland Department of the Environment PDWIS database)
- 2) Determine if radioactivity is restricted to specific zones
- 3) Identify nearby wells that may be at risk for elevated radioactivity (particularly residential wells)

URANIUM-238 DECAY SERIES



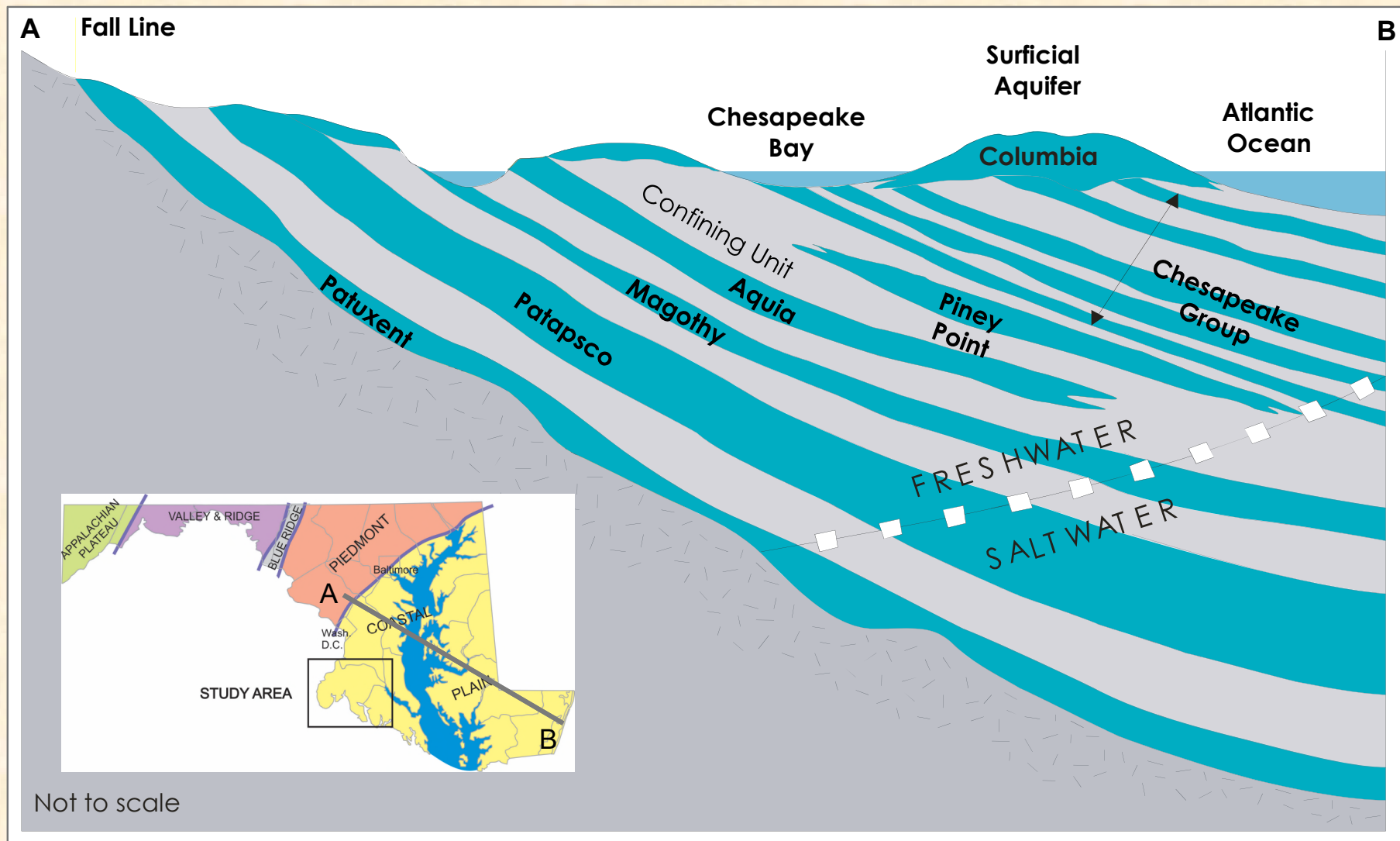
THORIUM-232 DECAY SERIES



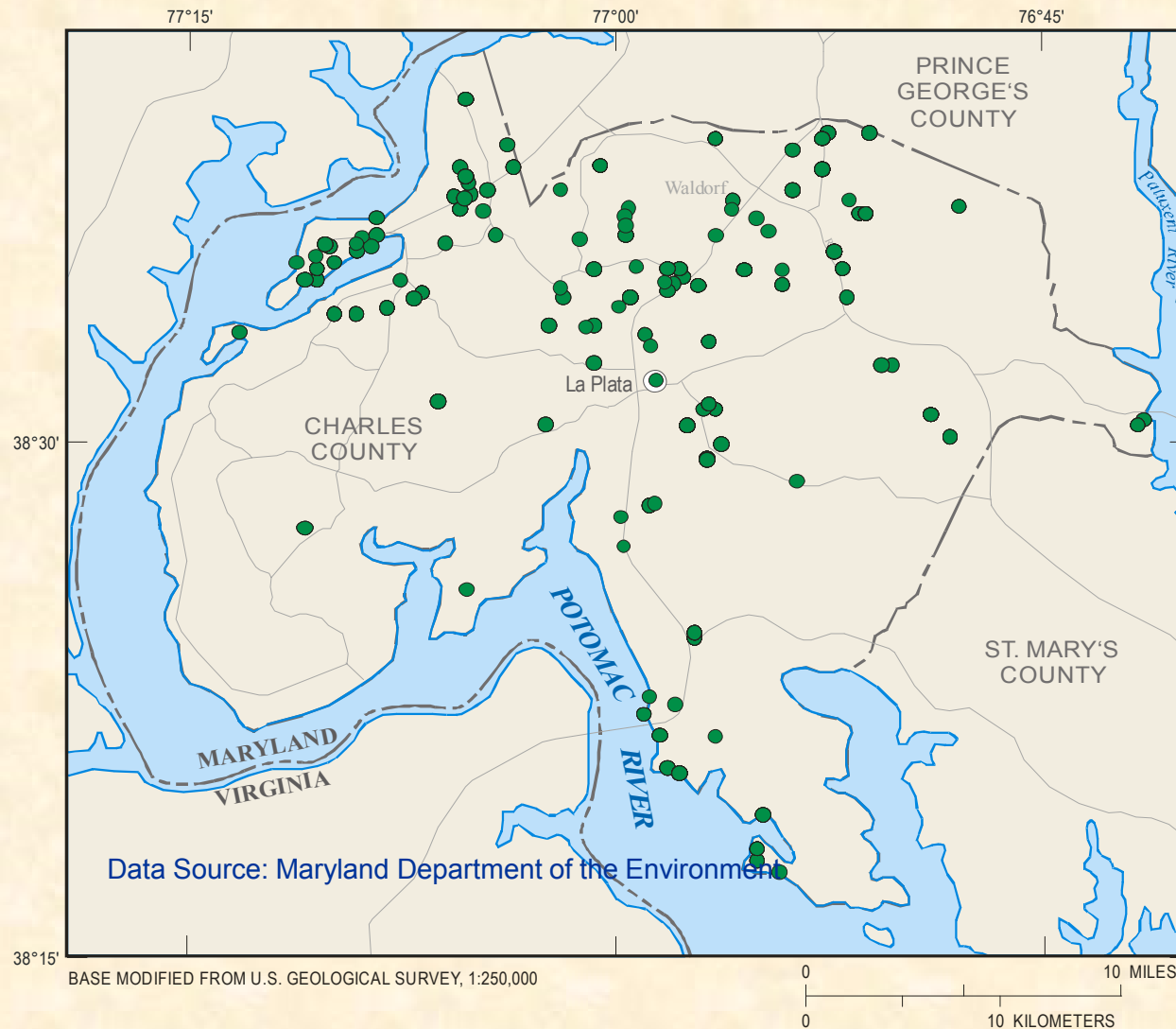
EXPLANATION

- ↓ Alpha decay
- ↗ Beta decay
- % percent

Generalized Cross Section Through the Maryland Coastal Plain



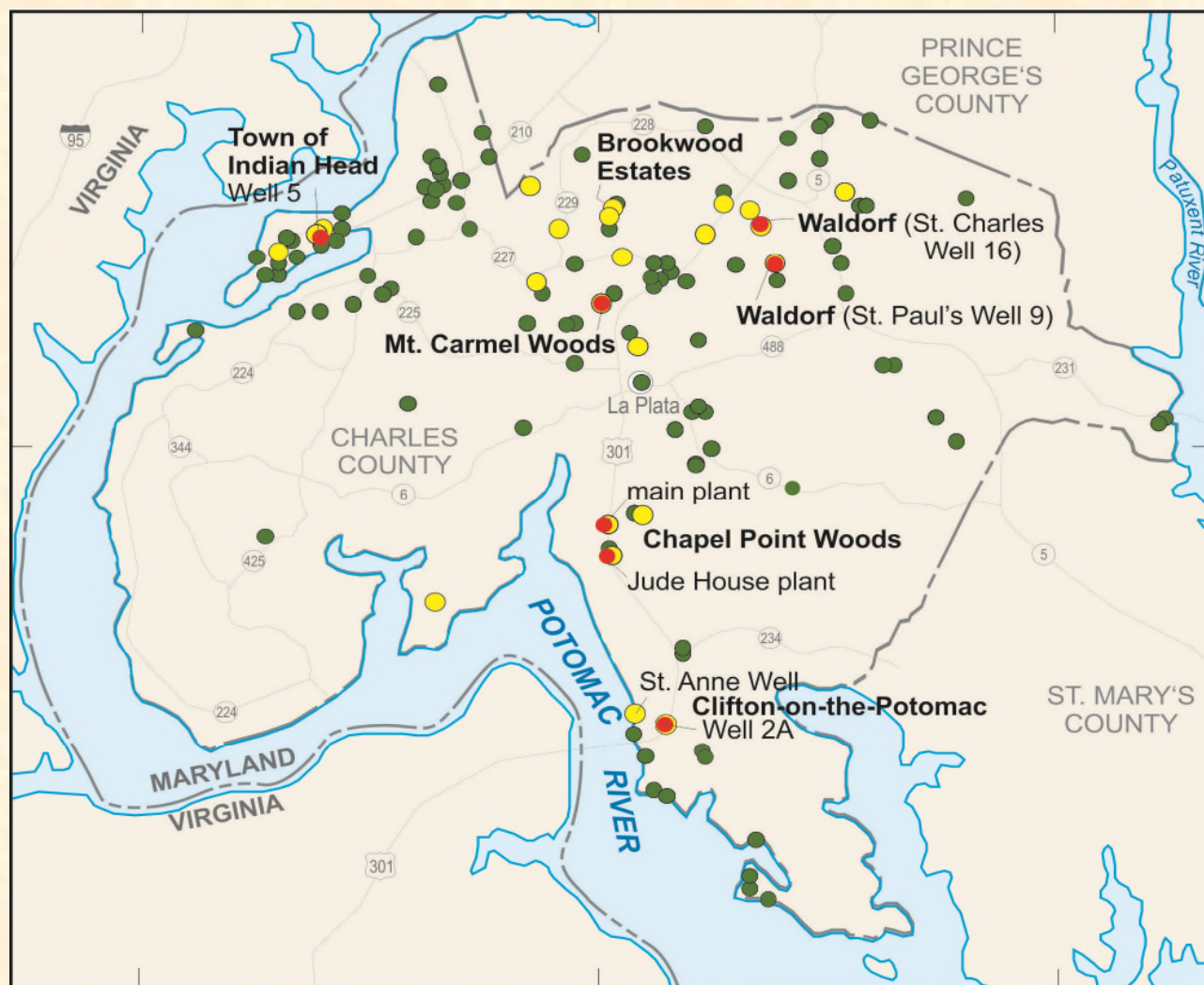
Objective #1: Compile and document existing data



78 public water systems (PWS) tested:

- 58 community (municipal supply)
- 20 non-community (mostly schools)

Gross alpha-particle activity



78 systems tested:

- 5 systems > 15 pCi/L
- 11 systems between 10-15 pCi/L
- 62 systems < 10 pCi/L (most < 3 pCi/L)

EXPLANATION

Gross alpha-particle activity, in picocuries per liter

- Less than 10
- 10 to 15
- Greater than 15

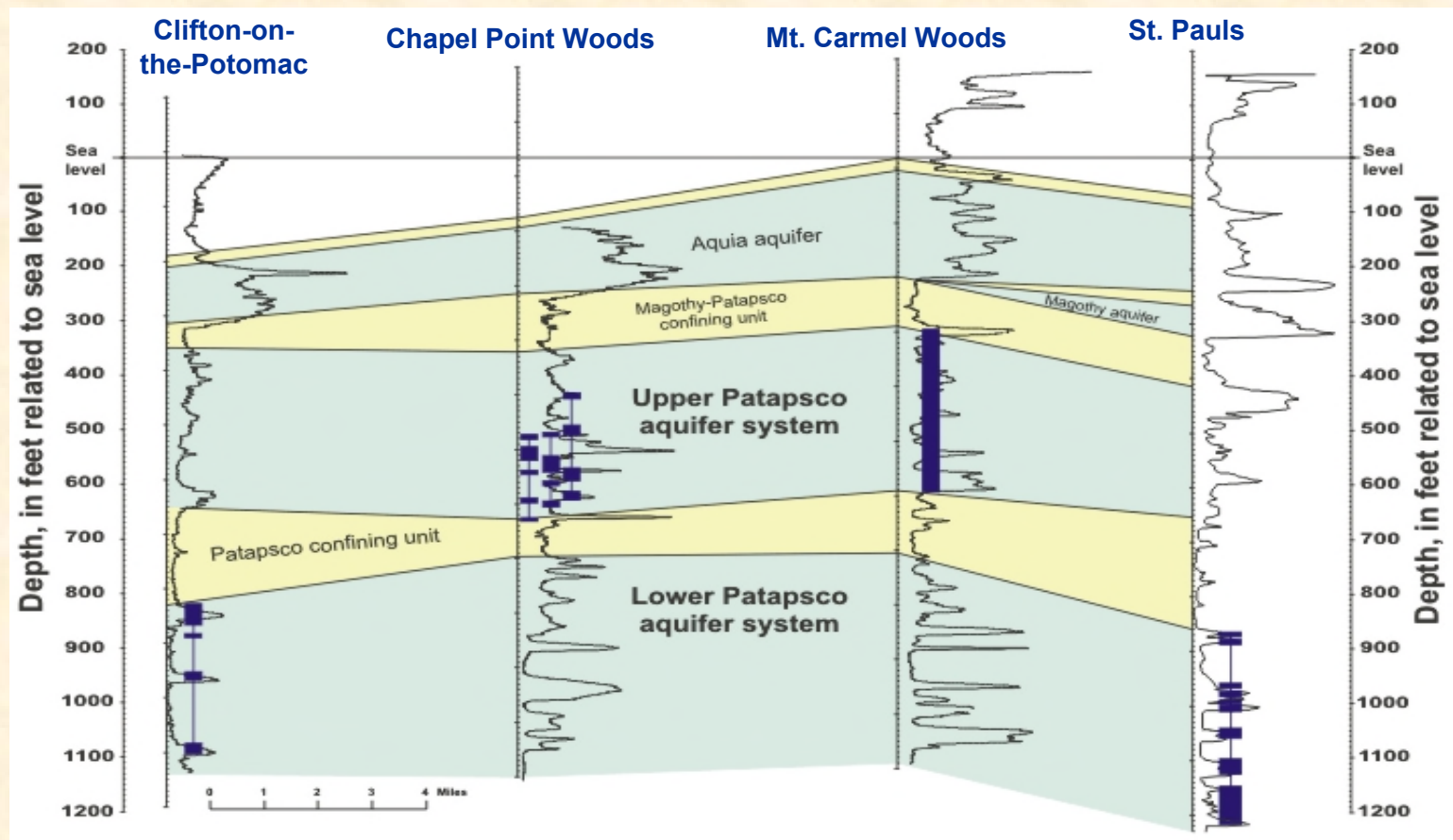
Radionuclide Concentrations (78 PWS)

Radionuclide	Range (pCi/L)	Mean (pCi/L)	Maximum Contaminant Level (pCi/L)
Gross Alpha	0.2-122	10	15
Gross Beta	0.15 - 47	6.2	~50 pCi/L (4 mrem/yr)
Radium 226+228	0.1 – 4.6	1.1	5
Radium-224	Not tested but likely low		No MCL
Uranium	0.06 - 9.4 ug/L	1.9 ug/L	30ug/L
Po-210	2.8 – 46.6	23.1	No MCL

Polonium-210 in groundwater

- **Very rare**
 - Not often tested
 - Less than 100 wells nationwide reported levels greater than 5 pCi/L (Nevada, Virginia, Florida)
 - Highest in Charles County was 46.6 pCi/L
- **No MCL for Po-210**
- **“Activity level of concern” of 1.1 pCi/L**
(equivalent to risk level of combined radium at 5 pCi/L MCL) [U.S. EPA, 1999]
- **Occurrence/distribution**
 - Considerable data/knowledge gap
 - Mobilized in anoxic sulfate-reducing environments(?)

Objective #2: Are specific parts of the aquifer affected?



Water samples are a composite from multiple well screens spanning 900 feet of sediment

Upper, Lower Patapsco Aquifer (Potomac Group):

- Fluvio-deltaic system
- Southwest of main axis of deposition
(higher clay/silt fraction)

Sands:

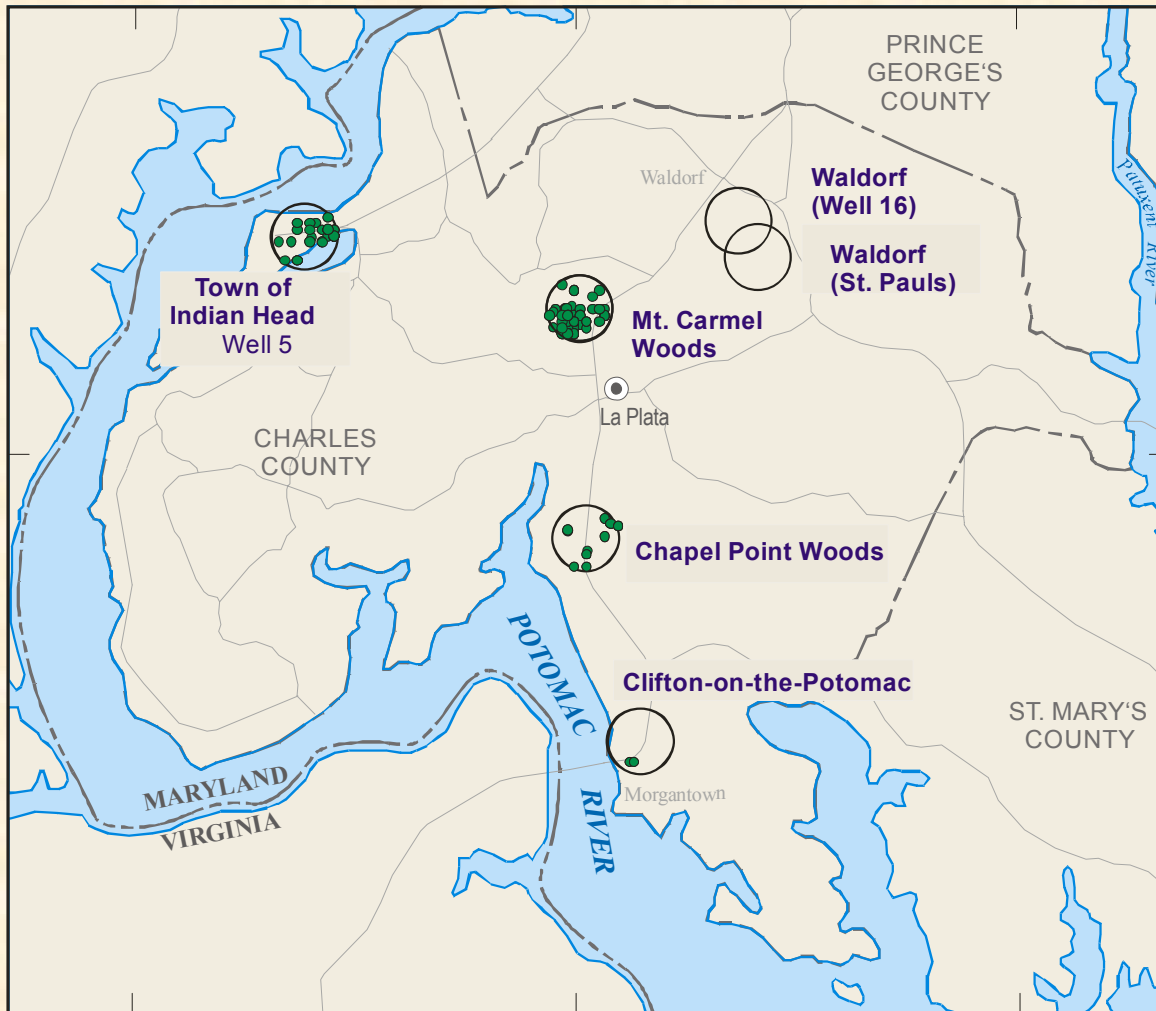
- Gray, greenish-gray; some yellow/reddish brown
- Predominantly subangular to subrounded quartz
(mostly colorless; some iron coatings)
- Accessory minerals: pyrite, lignite, muscovite

Clays:

- Highly variable color, texture
- Mostly medium-dark silty gray clays



Objective #3: Are private water wells at risk?



Process

Wells were identified that are completed in the U&L Patapsco aquifers within a 1-mile radius (location accuracy issues?)

Results

Total of 113 wells
93 residential
14 PWS (non-community)
6 irrigation/farm

Summary

- Radioactivity above MCL's is limited (5 PWS's out of 58 total)
- Po-210 is the likely source (at 2 PWS's and possibly more)
- Can't determine distribution within the aquifers (composite samples from multiple well screens)
- Significant number of wells likely screened at the same intervals located nearby (mostly residential)

What's Next?

- Sample ~90 public water-supply wells having GAPA 5-15 pCi/L (GAPA, GBPA, radium, Po-210, uranium)
- Sample ~30 private water wells near PWS wells with high GAPA (test for GAPA, GBPA only)
- After that.....???



Report available online at
Maryland Geological Survey website:
www.mgs.md.gov

Contacts:
David Bolton
(David.bolton@maryland.gov)
David Andreasen
(David.andreasen@maryland.gov)

Department of Natural Resources
Resource Assessment Service
MARYLAND GEOLOGICAL SURVEY
Richard A. Ott, Jr., Director

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**PRELIMINARY INVESTIGATION
OF ELEVATED RADIOACTIVITY IN GROUNDWATER
IN CHARLES COUNTY, MARYLAND**

by
David C. Andreasen and David W. Bolton



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